Brain Machine Interface: A New Vision and Mission for Blind Persons

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Abstract - Brain Machine Interface (BMI) is a most important technological breakthrough in decades. In recent years, progress is being made towards sensory substitution devices for the blind. In the long run, there could be the possibility of brain implants. A brain implant or cortical implant provides visual input from a camera directly to the brain via electrodes in contact with the visual cortex at the backside of the head. In this paper, we proposed some applications where BMI can be used effectively which are very much useful for the society.

Keywords: *Brain Machine Interface, Signal Processing*

1. Introduction

A brain-computer interface is defined as a direct connection between a human (or animal) brain with an external device. These connections range from non-invasive technologies that recognize brain signals externally, to invasive technologies that involve surgery and direct electrode implantation. Scientific Progress in recent years has successfully shown that, in principle, it is feasible to drive prostheses or computers using brain activity: Monkeys have learned to move a computer cursor or a robotic arm [1, 2]. People have learned to use simple prototypes to write short texts or to control technical devices [3, 4].

The focus of worldwide research in this new technology, known as brain-machine-, or brain-computer interface, has been based on two different prototypes: Non-invasive BMIs, which measure activity from large groups of neurons with electrodes placed on the surface of the scalp (EEG), and invasive BMIs, which measure activity from single neurons with miniature wires placed inside the brain.

We are investigating a new minimally invasive approach based on electrodes placed on the surface of the brain. This technology minimizes medical risks while still providing high signal quality. As the power of modern computers grows alongside our understanding of the human brain, we move ever closer to making some pretty spectacular science fiction into reality. Imagine transmitting signals directly to someone's brain that would allow them to see, hear or feel specific sensory inputs. Consider the potential to manipulate computers or machinery with nothing more than a thought. It isn't about convenience -- for severely disabled people, development of a brain-computer interface (BCI) could be the most important technological breakthrough in decades. In this article, we'll learn all about how BCIs work, their limitations and where they could be headed in the future. The Electric Brain

The reason a BCI works at all is because of the way our brains function. Our brains are filled with neurons, individual nerve cells connected to one another by dendrites and axons. Every time we think, move, feel or remember something, our neurons are at work. That work is carried out by small electric signals that zip from neuron to neuron as fast as 250 mph [source: Walker]. The signals are generated by differences in electric potential carried by ions on the membrane of each neuron.

Although the paths the signals take are insulated by something called myelin, some of the electric signal escapes. Scientists can detect those signals, interpret what they mean and use them to direct a device of some kind. It can also work the other way around. For example, researchers could figure out what signals are sent to the brain by the optic nerve when someone sees the color red. They could rig a camera that would send those exact signals into someone's brain whenever the camera saw red, allowing a blind person to "see" without eyes.

2. Literature Survey

Brain-computer interface is a method of communication based on neural activity generated by the brain and is independent of its normal output pathways of peripheral nerves and muscles. The neural activity used in BCI can be recorded using invasive or noninvasive techniques. The goal of BCI is not to determine a person's intent by eavesdropping on brain activity, but rather to provide a new channel of output for the brain that requires voluntary adaptive control by the user.[1]

The potential of BCI systems for helping handicapped people is obvious. There are several computer interfaces designed for disabled. Most of these systems, however, require some sort of reliable muscular control such as neck, head, eyes, or other facial muscles. It is important to note that although requiring only neural activity, BCI utilizes neural activity generated voluntarily by the user. Interfaces based on involuntary neural activity, such as those generated during an epileptic seizure, utilize many of the same components and principles as BCI, but are not included in this field. BCI systems, therefore, are especially useful for severely disabled, or locked-in, individuals with no reliable muscular control to interact with their surroundings. The focus of this chapter is on the basics of the technology involved and the methods used in BCI.[1]

3. Proposed Methodology

A computer is used to process the sensory streams, as is typical for a brain-computer interface (BCI). It is possible to give a vision to blind person using following method.

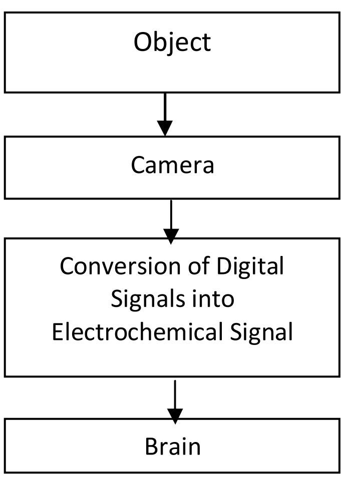

Figure 1: A Model of BMI

As blind person cannot see anything at all. So image can e captured with the help of a camera. Now captures image will be in the form of digital signature, and brain can recognize each thing in the form of electrochemical signal. So the task is to convert this digital signal into the electromagnetic signal, and then pass this electromagnetic signal to brain. Here main issue is how to convert this digital signal into electo-chemical signal.

Figure 2 shows that how we can embed a camera.

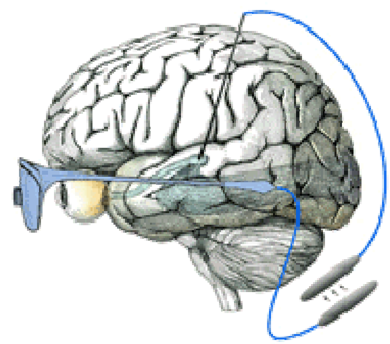

Figure 2: Interfacing of camera with brain

This tends to aims to demonstrate the feasibility of an electrode array implant to make an interface with the visual cortex Prosthesis simulation for virtual mobility task.

The main concept of visual prosthesis to be implanted into the visual cortex. The basic principle of technology consists of stimulating the visual cortex by implanting a silicon microchip on a network of electrodes, made of biocompatible materials, wherein each electrode injects a stimulating electrical current in order to provoke a series of luminous points to appear (an array of pixels) in the field of vision of the blind person.

This system is composed of two distinct parts: the implant and an external controller. The implant is lodged in the visual cortex and wirelessly receives data and energy from the external controller. It contains all the circuits necessary to generate the electrical stimuli and to monitor the changing microelectrode/biological tissue interface. The battery-operated outer controller consists of a micro-camera, which captures images, as well as a processor and a command generator, which process the imaging data to translate the captured images and generate and manage the electrical stimulation process. The external controller and the implant exchange data in both directions by a transcutaneous radio frequency (RF) link, which also powers the implant.

Even if you wear eyeglasses, your vision is probably good enough that you can recognize the small letters on this page. Text on most computer screens is about 3 millimeters tall and 2 mm wide (.12 x .08 inches). As you read this one sentence, you are probably oblivious to the thousands of pieces of visual information that your eyes are gathering each second. Just in the retina alone, there are millions of cells at work right now acting as photoreceptors reacting to light, similar to how a camera works to capture images on film.

The retina is a thin layer of neural tissue that lines the back wall inside the eye. Some of these cells act to receive light, while others interpret the information and send messages to the brain through the optic nerve. This is part of the process that enables you to see. In damaged or dysfunctional retinas, the photoreceptors stop working, causing blindness. By some estimates, there are more than 10 million people worldwide affected by retinal diseases that lead to loss of vision.

Until now, those who lost their vision to retinal disease would have had little hope of regaining it. But technological breakthroughs could soon give back the gift of sight. Several groups of scientists have already developed silicon microchips that can create artificial vision. In this article, we will examine how your retinas work and why blindness caused by retinal disease no longer means the loss of vision.

4. Conclusion

This paper presented that we can interface a camera with brain and can send images captured by that camera by converting them into electrochemical signals. If we successfully implement this concept, then very useful devices can be made which will be very useful for blind persons. The technology of brain-computer interface systems has a number of viable uses. Whether they are used to help the physically and mentally disabled interface with household objects, allow users to remotely play video games and use computers, enable people to scan images, decipher intentions, or to control the movement of animals for military research, BCI's are an inevitable part of our future.

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